rotary thumbwheel switch construction

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abstract

one or more rotary switch constructions or units, each including a plurality of interfitting component parts, arranged for rapid sequential production line assembly along a common assembly axis and held in assembly with housing portions under virtually uniform contact by a single shaft and external nut restraint means at opposite ends of the shaft. Each switch unit includes a switch housing having a sidewall and an open side opposite thereto, a printed circuit board positioned within said housing and selectively engageable by a circuit selecting brush carried on a rotatably mounted wheel having peripheral portions projecting through an opening in said housing for rotation of said wheel, means to selectively correlate rotation of the wheel with circuits to be selected, and a single shaft holding means extending through aligned ports in said end walls, sidewall, printed circuit board, and wheel.

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7 claims, 9 drawing figures
ROTARY THUMBWHEEL SWITCH CONSTRUCTION

BACKGROUND OF THE INVENTION:

Prior proposed digital rotary wheel switch constructions having a rotatable thumbwheel carrying a plurality of brushes for selected electrical contact with electrical circuit paths on a printed circuit board are shown in United States Pat. Nos. 2,853,564; 2,896,033; 3,089,923; and 3,499,127. In the more sophisticated prior designs, such as in the switch constructions of the latter two patents, the individual switch constructions are arranged in alignment to form a switch bank including a selected number of individual switch constructions.

Typically, a prior proposed individual switch construction is provided with at least two holes transverse of the switch housing at the rear wall thereof, through which long threaded bolts extend to align adjacent housings and to hold the switch constructions between two end brackets of the switch bank.

The threaded rods extending through the switch constructions at the rear edge walls of the housing press the housings in the bank together along the rear wall thereof, but the individual housings separate at the junctures thereof along the front edge walls and admit dust and dirt into the switch construction. The separation of these switch constructions at their front wall junctions also presents an unsightly unattractive interrupted or gapped surface at the front of the switch bank.

Additionally, another disadvantage of the prior art rotary wheel switch constructions is that each must be pre-assembled individually prior to their final assembly on such long threaded rods into the switch banks. In such pre-assembly some prior rotary wheel switches included wheel axles mounted within the housing, that is, at least one end of the axle did not extend through a housing sidewall, the wheel mounting means being provided within the housing. Small and manually placed metal rivets were often used to fix the position of certain parts. Placement of pins limiting wheel rotation for correlation with a selected printed circuit board was sometimes not only initially awkward and difficult to locate, but later was not readily modified or changed.

Thus, assembly of prior switch constructions was time consuming, expensive, parts were small and difficult to handle and assemble, printed circuit boards were locked in housing parts and replaceable only by substantial disassembly of the switch construction, and even when such prior constructions were fully assembled, additional assembly operations were necessary to gang the constructions together in a switch bank.

SUMMARY OF THE INVENTION:

The present invention relates to sectional and digital rotary wheel constructions for use with printed circuit boards and more particularly to a switch construction which obviates the disadvantages of prior switch constructions as mentioned above and affords new advantages in such a switch construction.

Therefore, it is the primary object of this invention to provide a novel rotary wheel switch construction in which the component parts thereof are assembled and held in assembly in a novel manner.

An object of the present invention is to provide a rotary wheel switch unit in which each unit is snugly and closely held in contact with the adjacent unit throughout the periphery of the unit.

Another object of the present invention is to disclose and provide a novel method and construction for assembly of such a switch unit in a novel manner and wherein pre-setting of limits of rotation of a rotary switch wheel is facilitated and readily modified or changed.

Another object of the present invention is to disclose a novel rotary wheel switch construction providing a minimum of component parts and arranged for rapid, facile assembly in a production line whereby costs of assembly are substantially reduced.

Other and additional objects of this invention are to provide a switch construction which is internally assembled at the same time that it is assembled into switch banks, and to provide such a switch construction which is easily and economically assembled.

Generally speaking, the invention contemplates a rotary wheel switch construction for use with a printed circuit board to facilitate the selection of the electrical circuits thereon including a housing with edge walls and a sidewall extending between the edge walls to form an open sided cavity, a rotatable wheel received within the cavity of the housing, spring means mounted inside housing to hold the wheel in one of a number of selected rotational positions, locating means locating the printed circuit board in cooperative position with respect to the wheel, circuit means carried by said wheel and contacting the circuits on the printed circuit board, and a removable side wall closing the open sided cavity of the housing, with the improvement according to this invention which adapts the switch construction for ready assembly including the provision of central through ports in the sidewall of the housing, the wheel and the removable sidewall, a through port in the circuit board located for alignment with the port of the housing when the circuit board is located in the housing, a single shaft extending through said ports for mounting the housing, wheel, printed circuit board and sidewall on a common axis, and axial restraint means on the shaft for holding the housing, wheel, printed circuit board, and side wall in assembly on said shaft and to maintain the removable sidewall against the edge walls of the housing to close the cavity. The housing sidewall may have a boss extending into the cavity with a circular recess coaxial with the port, and the wheel may have a hub coaxial with the wheel port for being loosely received in a circular recess to position the wheel port coaxial with the housing port for insertion of the shaft. The locating means may include opposed channels on the switch housing for slidably receiving and positioning the printed circuit board with respect to the wheel and the housing. A plurality of like switch constructions may be assembled on a single shaft between the end brackets with or without spacer housings, into a switch bank.

Other objects and advantages of the present invention will be readily apparent from the following description of the drawings in which an exemplary embodiment of this invention is shown.
BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. 1 is a front elevational view of a rotary wheel switch construction embodying this invention;

FIG. 2 is a cross-sectional view taken along vertical planes II—II of FIG. 1 and at a joint plane between an end wall and an adjacent switch housing with the circuit board removed;

FIG. 3 is a cross-sectional view taken along the vertical plane III—III OF FIG. 1 showing a printed circuit board located in the housing;

FIG. 4 is a cross-sectional view taken along a vertical transverse plane of FIG. 2 showing the single shaft aligning and maintaining the major parts of the switch construction in assembly;

FIG. 5 is a cross-sectional view taken along a vertical plane V—V of FIG. 4 showing the side of the thumbwheel opposite to that shown in FIG. 2;

FIG. 6 is a cross-sectional view taken along a vertical plane VI—VI of FIG. 4 showing the internal surface of the integral side wall of the switch housing;

FIG. 7 is an exploded perspective assembly view of the rotary switch construction of FIG. 1;

FIG. 8 is a front elevation view of a bank of assembled rotary wheel switch constructions embodying this invention; and

FIG. 9 is a perspective view of a spacer housing for use with the switch constructions of FIG. 1 in the switch bank of FIG. 8.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT:

Referring now to the drawings, and particularly to FIG. 1, the rotary wheel switch construction, with the improvements according to this invention, is generally denoted by the numeral 10. The switch construction 10 is for use with a printed circuit board 11 which as best seen in FIG. 3, has a pattern of electrical circuits or paths 12 and connecting blades 13 on one side or both sides, if desired, of a rectangular base 14 of dielectric material.

Generally, rotary wheel switch construction 10 includes a switch body housing 15 having a side opening cavity 21, a cup-shaped wheel 30 insertable within housing cavity 21, spring means 40 for releasably holding wheel 30 in a selected one of several positions, printed circuit board locating means 45 for locating the printed circuit board 11 in housing 15, circuit brush means 50 carried by wheel 30 for selecting an electrical circuit 12 on the printed circuit board 11, a removable end mounting bracket 57 closing housing cavity 21 and limit pins 65 for a construction and arrangement of these component parts to facilitate direct virtually sequential rapid assembly of the parts about a common axis assembly limiting rotation of wheel 30 if desired. The improvement according to this invention includes a single shaft 70 extending through aligned ports in housing 15, wheel 30, printed circuit board 11 and removable end wall 56 with external nuts or axial restraint means 72 on the shaft 70 holding these assembled parts together.

Referring now to FIG. 7, the switch body housing 15 has a front edge wall 16, a top edge wall 17, a back edge wall 18 and a bottom edge wall 19 with an integral side wall 23 therebetween. The edge walls 16, 17, 18 and 19 and the integral sidewall 23 define a cavity 21 opening to the side opposite to wall 23. The front edge wall 16 has a wheel access opening 22 and a dial opening 22a. The openings 22, 22a together form a sideways T-shape, the head of the T extending into border projections 24 having opposed surfaces sloping towards the openings 22 and 22a. The housing 15 as well as most of the other parts of the construction 10 may be molded out of a suitable dielectric plastic material.

Additionally, as best illustrated in FIG. 6, the integral side wall 23 has a centrally located boss 25 extending into cavity 21. The boss 25 has a central through port 26 also through wall 23 and with a co-axial circular recess 27 therearound and facing the open side of cavity 21. A series of pin receiving holes or apertures 28 extend through boss 25 and the wall 23 and are circularly arranged in equal spaced relationship for receiving limit pins 65, such openings 28 being accessible at the face of wall 23 opposite to cavity 21.

Returning now to FIG. 7, cup-shaped wheel 30 includes a tooth wheel portion 31 having a plurality of radially extending teeth 32, typically 10 in number, with a like number of arcuate depressions 33 therebetween. A cylindrical dial wheel portion 34 is integrally formed with the tooth wheel portion 31 and extends to the left thereof. The dial wheel portion is provided with numerals typically 1 through 9 and 0 located thereon corresponding to the locations of the teeth 32 on the wheel portion 31.

The cup-shaped wheel 30 also has a hub 35 which, as best seen in FIG. 4, projects in opposite directions from the dial wheel portion 34. The hub 35 has a central, through port 36. As best seen in FIG. 5, the hub 35 defines the inner boundary of an arcuate cavity 37, the outer boundary of which is defined by the dial wheel cylindrical portion 34 itself. A radial wall 38 extends from hub 35 to the dial wheel portion 34 across the arcuate cavity 37 for a purpose which will appear later.

The spring means 40 of the rotary wheel construction 10, as best seen in FIG. 2, includes opposed upper and lower spaced spring retainer lugs 41 extending longitudinally on the inner surfaces of the top edge and bottom edge walls 17 and 19 at the back edge wall 18.

The spring means 40 also includes a leaf spring 42 of bent flat spring stock having a base portion 43 and a wheel positioning portion 44 cantilevered therefrom and having a convex end section receivable between adjacent teeth 32.

The printed circuit board locating means 45 of the switch body housing 15, as best seen in FIG. 4, includes channel or guide means 46 comprising opposed internal channels 47 in walls 17 and 19 adjacent the open side of housing 15. The channels 47 receive longitudinal edge margins 48 of printed circuit board 11 to slidably guide the printed circuit board 11 into the housing 15 until the front edge thereof engages the rear surface of front wall 16. In this position, a through port 49 in the printed circuit board 11 is co-axially aligned with port 26 of the housing 15 for a purpose which will appear later.

The circuit brush means 50 for selecting the electrical circuits 12 in response to rotation of the wheel 30 as best seen in FIGS. 7 and 2, includes a thin metal plate 51 with apertures therein for receiving a nub 52 on the dial wheel portion 34 and a screw 53 to non-rotatably
secure the plate 51 to dial wheel portion 34. The plate has, integrally formed and radially spaced on the dial wheel portion 34, fingers 54 for engaging particular electrical circuits 12 on the printed circuit board 11 to select the electrical circuits 12 in response to rotation of the wheel 30.

The removable end mounting bracket 57 of the rotary wheel construction 10 may include an end wall 56 (FIG. 7) having a through port 58 and means for aligning in assembly and in registry the adjacent housing 15. In the preferred embodiment, the register means includes mating holes and dowels 60 and 61 on both end wall 56 and both lateral edges of front wall 16. The hole and dowel combinations are so located that end wall 56 may be placed either over housing cavity 21 or against integral sidewall 23 by reversing end bracket 57 so as to cooperably interengage a dowel with a hole.

The end bracket 57 also has an integral front wall 62 giving the end bracket 57 an L-shaped horizontal cross section. The front wall 62 has border projections 63 extending therefrom in U-shape and open toward the end wall 56. The front wall 62 also is provided with two mounting holes 64 for mounting the assembled rotary wheel switch construction 10 to an electrical instrument panel with which it is used.

The rotary wheel switch construction 10 is also provided with limit pins 65 which, as best seen in FIG. 4, are received in the pin receiving holes or apertures 28 in the integral sidewall 23 of housing 15. The limit pins are so sized as to be frictionally held within holes 28.

The rotary wheel switch construction 10, as best seen in FIGS. 4 and 7, is assembled on a single shaft 70 having threaded ends 71 which receive axial restraining means 72, typically nuts 73. The shaft 70 may be of any suitable length as seen by comparing FIGS. 4 for a single rotary wheel switch construction as shown and FIG. 8 where the rotary wheel constructions 10 are mounted together on a single shaft 70 to form a switch bank.

In a switch bank, each side wall 23 would serve to cover the open side of an adjacent housing, removable walls 56 being located at ends of the bank. Also, a suitable number of spacer housings 15a may be required to space certain switch constructions 10 from one another. The spacer housing 15a has front edge wall 16a, top edge wall 17a, back edge wall 18a, bottom edge wall 19a and integral sidewall 23a forming again an open sided cavity 21a. The integral sidewall 23a would also have a central through port 26a.

In assembly of the switch construction described above, leaf spring 42 may be inserted between spring retainer lugs 41 and integral sidewall 23. Cup-shaped wheel 30 with brush means 54 attached thereto is then inserted into the open side of cavity 21 and tilted to position teeth 32 in the wheel access opening 22 and then permitting hub 35 to drop into the circular recess 27 of boss 25. Printed circuit board 11 is then slidably inserted from the rear of the housing into the channels 47 until the front edge of the printed circuit board 11 is stopped against the front wall 16 in the housing. End wall 56 of the end bracket 57 is placed over the cavity 21 with the dowels 60 extending into the holes 61 to provide registry between the end bracket 57 and the housing 15. The housing may now be turned over and two limit pins 65 inserted into desired apertures 28 in the integral sidewall 23 if it is desired to limit rotation of the wheel 30. A second end bracket 57 may be placed against the integral sidewall 23 of housing 15 with the dowels 61 extending into the holes 60 to provide registry therebetween. While the loosely positioned and aligned parts are held together, the single shaft 70 is inserted through the ports 26, 36, 49, and 58 to precisely align the parts on a single axis and the nuts 73 threaded onto the end 71 of the shaft 70 and against the end walls 56 of the end brackets 57 to hold the rotary wheel switch construction 10 together. The generally central location of the shaft and of nuts 73 with respect to end walls 56 will transmit pressure evenly to the edge walls 16, 17, 18, and 19 of the switch body housing 15 to keep the junctures therebetween tightly closed.

If it is desired to mount the rotary wheel switch constructions in a switch bank as is shown in FIG. 8, the steps would be essentially the same for each rotary wheel switch construction 10. It may be helpful, however, to provide an assembly fixture (not shown) having a rod the diameter of the shaft 70, extending outwardly from the assembly fixture to sequentially receive the individual wheel constructions 10 and any spacer bodies 15a that may be required. In such multiple switch assemblies, removable end brackets 57 are located at the ends of the assembly. Sidewalls 23, 23a of housing 15 and spacer housing 15a cover respective cavities 21, 21a so that each switch housing 15 with associated parts is adapted to be separably operable.

Once a suitable number of switch constructions 10 and spacers 15a with two end mounting brackets 57 have been inserted onto the fixture rod, the single shaft 70 may be coaxially aligned with the fixture rod and the switch bank slid from the fixture rod onto the shaft 70, with the nuts 73 being turned onto the threaded ends 71 thereof to hold the switch bank together. It may be desirable to have the fixture rod be the single shaft 70 itself and thereby further simplify the assembly.

Once the rotary wheel switch construction has been assembled, manual finger engagement with teeth 33 extending through the wheel access opening 22 of the front wall 16 will turn the cup-shaped wheel 30, against the action of the leaf spring 42, until the wheel portion 44 thereof moves from the depression 33 over the tooth 32 adjacent thereto and into the next depression 33 to index the wheel 30 and to move the fingers 54 along the printed circuit board 11 and thereby change the electrical connection of the circuits 12 thereon. The pressure action of the convex bent end of the leaf spring 42 may also move the next tooth 33 into the wheel access opening 17 to protrude therefrom, between the border portions 19, as the first tooth 33 is now located inwardly of the surface of border projections 24. The cup-shaped wheel 30 may be successively indexed by this method until the radial wall 38 of the wheel engages the one of the limit pins 65 to prevent further rotation of the wheel in that direction.

Thus, rotary wheel switch construction 10 embodying this invention includes a single assembly shaft 70 which serves to align the parts during assembly and holds the parts in close aligned tight assembly during use and operation. It will be readily apparent that rapid assembly is facilitated as well as disassembly for repair, maintenance, or replacement of parts of the switch and particularly the printed circuit board, brush means, wheel, and limit pins therefor.
For example, removal of one end mounting bracket 57 (at the right of FIG. 4) exposes holes 28 in which wheel limiting pins 65 are held. Pins 65 may be relocated, added to, or otherwise changed in position to obtain the desired circuit performance. The advantages of accessibility of the pins 65 in the through holes 28 are readily apparent.

In addition, the circuit board 11 and the brush means 51 are readily changeable by withdrawing shaft 70, separating a switch housing from an assembly of housings, withdrawing the circuit board, and then changing the brush means on the wheel. Thus, repair or replacement of the circuit board and brush means is facilitated by the switch construction of this invention. Moreover, a supply of circuit boards and companion brush means may be stocked for use instead of entire switch constructions.

It should also be noted that the single shaft may be made of suitable steel or other metal material which has good bearing or antifriction characteristics with the plastic material of the rotatable wheel so that a smooth enhanced operation is provided together with reliability.

Various changes may be made in the switch construction described above and all such changes coming within the scope of the appended claims are embraced thereby.

I claim:

1. In a unitary rotary switch construction adapted for assembly with one or more like switch constructions and to maintain a tight dust-proof assembly of such one or more unitary rotary switch constructions, the combination of:

   a housing means provided with an interior cavity open at one side of the housing means,
   said housing means including a sidewall opposite said opening and top, bottom, front, and back edge walls;

   a rotatable wheel having an annular recess facing said side wall within said cavity and with a toothed peripheral portion extending through an opening in said front wall,
   said wheel carrying circuit contacting means on the wheel face opposite to said wheel recess;

   spring means carried by the housing to retain said rotatable wheel in a selected position;

   a printed circuit board positionable adjacent said rotatable wheel face for contact by said circuit contacting means;

   means on said top, bottom, and front edge walls engaging said circuit board to position said board relative to said circuit contacting means;

   a pair of end mounting bracket means at opposite side of said housing means,

   each including a bracket wall, the wall of one bracket closing said cavity opening and seated against sidewardly facing edges of said edge walls of the housing means,

   the wall of the other bracket means being seated against the face of said side wall;

   and means including a single shaft and nut means for holding said housing means, bracket means, rotatable wheel, and circuit board in operative assembly,

   said housing means, bracket means, wheel, and circuit board being provided with aligned openings on the axis of said shaft to receive said single shaft, whereby said bracket walls transmit uniform sealing pressure of said shaft and nut means to said housing means for maintaining a tight housing assembly.

2. In a construction as stated in claim 1 wherein said bracket means are moveable into spaced relation from said housing means along said single shaft, and additional like housing means with rotatable wheel and circuit board assembled therewith are mounted on said shaft and held in operative assembly thereby, the sidewall of one housing means being in cooperable sealing engagement with the edge walls of an adjacent housing means except for the one housing means located at one of the ends of said shaft.

3. In a construction as stated in claim 1 wherein said circuit board engagement means includes grooves in interior faces of said top, bottom and front edge walls lying in a common plane to slidably receive edge margins of said circuit board.

4. In a construction as stated in claim 3 wherein, said back wall of said housing means includes a through-slot in said common plane for said circuit board,

   said single shaft retaining said circuit board in assembly with said housing means and wheel whereby axial withdrawal of said shaft beyond a circuit board provides withdrawal of said circuit board through said slot and replacement thereof with another selected circuit board.

5. In a construction as stated in claim 1 wherein said housing means and said bracket means are provided with cooperable register means to maintain lateral relationship thereof during withdrawal of said single shaft.

6. In a construction as stated in claim 2 including spacer means interposed between spaced housing means, said spacer means having a wall for closing said cavity opening in an adjacent housing means and having a port to receive said shaft.

7. In a unitary rotary wheel switch construction adapted to provide a dust-proof assembly and to provide replacement of a circuit board without complete disassembly of the construction, the combination of:

   a housing means provided with an interior cavity open at one side of the housing means, said housing means including a sidewall opposite said opening and top, bottom, and front edge walls;

   a rotatable wheel within said cavity and having a toothed peripheral portion extending through an opening in said front wall,

   said wheel having an annular recess facing said side wall and having circuit contacting means on the wheel face opposite to said recess;

   a printed circuit board positionably adjacent said rotatable wheel face for contact by said circuit contacting means;

   means on said top, bottom and front edge walls engaging said circuit board to position said board relative to said circuit contacting means;

   a pair of end mounting bracket means at opposite side of said housing means,

   said housing means, bracket means, wheel, and circuit board being provided with aligned openings on the axis of said shaft to receive said single shaft, whereby said bracket walls transmit uniform sealing pressure of said shaft and nut means to said housing means for maintaining a tight housing assembly.

8. In a construction as stated in claim 1 wherein said bracket means are moveable into spaced relation from said housing means along said single shaft, and additional like housing means with rotatable wheel and circuit board assembled therewith are mounted on said shaft and held in operative assembly thereby, the sidewall of one housing means being in cooperable sealing engagement with the edge walls of an adjacent housing means except for the one housing means located at one of the ends of said shaft.
and means including a removable single shaft and nut means for holding said housing means, mounting means, rotatable wheel, and circuit board in operative assembly, said housing means, mounting means, wheel, and circuit board being provided with aligned openings on the axis of said wheel to receive said single shaft by movement thereof in an axial direction, said shaft and nut means transmitting through said bracket wall and said sidewall uniform sealing pressure to said edges of said edge walls for maintaining a tight housing assembly.